

DESCRIPTION
OF
THE CINEMATOGAPHE

OF
August and Louis LUMIERE.

The principle of the Cinematographe.

Among the numerous applications to which instantaneous photography has given birth, it may be said to-day that Chrono-Photography or Animated Photography, occupies the first place.

Ever since the introduction of the rapid Bromo-Gelatine process Scientists have been experimenting with a view of using photography for the purpose of recording fugitive scenes that they might afterwards study the various phases of motion at their leisure.

In 1874, Mr. Johnson used an apparatus which he called the "Photographic Revolver" for the observation of important astronomical phenomena, and about the same time, Mr. Mays bridge, of San Francisco, obtained a series of instantaneous

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photographs of objects in motion by means of several special Cameras, the shutters of which were electrically opened and closed at suitable intervals. But it was Mr Marey, a member of the Institute of France, who obtained the most complete results in this direction. This Savant always used Chrono-Photography in the study of animal locomotion and we owe to him many ingenious discoveries which have proved valuable auxiliaries to the science of photographic observation.

Later on Mr Anschutz, General Sebert, and others made similar experiments, but all of these Savants were intent upon producing successive photographs (of objects in motion) to a limited number only and for the sole purpose of making *analysis* of motion; but the reconstitution of this motion, that is to say, its *synthesis*, was then considered a problem the solution of which was very difficult.

In 1893 Mr Edison placed before the public an apparatus called the "Kinetoscope" which exhibited (*to one spectator only*) a long series of instantaneous photographs following each other at very short intervals, realizing thus this synthesis.

But the film, on which the pictures are taken, being animated by a continual motion, each picture, to give a clear impression, ought to be seen but for a very short time, not exceeding $1/7000$ of a second. Under these conditions the light appeared to be very faint, the scenes having little depth and at least 30 pictures per second were necessary in order to produce an impression of sufficient continuity.

These defects have been eliminated by the "Cinematograph" and the ingenious construction of the instrument allows a reduction in the number of pictures to only 15 per second or even less. This reduction in speed allows more time for the exposure of the negative strip and hence clearer pictures are obtained. The Film strip being also made more translucent than that used upon the Kinetoscope and each picture being brought to a full-stop before the opening, so much more illumination is obtained that it is possible to project upon a screen

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before a large audience animated scenes in which the persons or moving objects are enlarged to full life size.

The principle of imparting apparent life motion to pictures has long been known; it was first crudely adapted to children's toys known as Zootropes, Praxinoscopes, Phenakistiscopes, etc. It is the principle of persistence of luminary impressions upon the retina of the eye.

When we see an object, its image is formed in the depth of our eye and is momentarily photographed on the nervous membrane which is called the retina. If the object be suddenly removed or darkened, its image fades from our vision gradually and the optic nerve being still affected, our eye persists in seeing the object as if it had neither been removed or darkened. The duration of this impression varies according to the intensity of the light upon the object. Under ordinary circumstances it is about $\frac{1}{10}$ of a second; in such a manner that the visibility of an object, which has suddenly been darkened, is prolonged of $2/45$ of a second. The result is that if a lighted object is placed before our eye and is suddenly hidden or removed during only $\frac{1}{45}$ of a second, its image will remain in our eye during $1/45$ of a second and we cannot perceive its momentary disappearance. Now, supposing that the successive positions of an object in motion be photographed upon a strip of film at intervals of $1/15$ ($3/45$) of a second. The different photographs obtained are alike, that is to say, that if we place one of them upon the other, the parts which represent fixed objects are got again exactly, whilst those corresponding with the object in motion occupy positions the flight of which measures in some way the removal accomplished between the instants when the two photographs were taken. That stated, let us say that 900 successive pictures will have thus been taken during one minute. Then let us project on a screen by means of a lantern, picture n° 1. Let us afterwards hide it, in interposing on the luminous group a dark shutter that will hide the light only for $\frac{1}{45}$ of a second, and, as above stated, our eye will go on seeing the projected image not only during all the time of the passage of the dark shutter, but still after it has passed during an equal time to the difference

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between $\frac{2}{45}$ of a second (the duration of the persistence) and $\frac{1}{45}$ of a second (the duration of the passage of the shutter), say $\frac{1}{45}$ of a second. Then supposing that during the time of its eclipse we substitute picture n° 2 in place of picture n° 1, when the screen unmasks the luminous group again, we will still continue to retain for $\frac{1}{45}$ of a second the impression of image n° 1 upon which the image n° 2 is strongly superimposed and as the motionless objects exactly coincide, our eye will perceive only the slightly changed attitude of the moving object in picture n° 2 succeeding to picture n° 1. In the same manner we substitute picture after picture until we get to n° 900 and our eye will have before it during these substitutions the object in motion during its various attitudes from 1 to 900.

Our eye will thus see moving on the screen the photography of this object.

The "Cinematographe" is an apparatus which enables us to produce automatically 900 eclipses of light in one minute and 900 substitutions of successive images.

In the "Cinematographe" these eclipses are obtained by the use of a segmental shutter revolving 45 times per second between the light and the objective or projecting lens, back of which the pictures pass through a framing device. At each passage the shutter will intercept the light and, consequently, the illumination of the screen, on which the projection is done, will disappear during a fraction of a second inferior to $\frac{1}{45}$.

As before stated, all these pictures are printed one after the other, edge to edge, upon a film about 17 metres in length and 35 millimetres in width. The dimensions of each picture are 25 millimetres in width and 20 millimetres in height. The margins of this film strip are perforated at intervals of 20 millimetres into which perforations two hooks, operated by a cam or eccentric movement, penetrate and jerk the strip downward through the framing device at regular intervals coinciding with the eclipses produced by the shutter. Thus, while the shutter is passing across the line of light, picture n° 1 is being sharply removed from before the opening or frame and picture n° 2 is substituted exactly in its stead. As soon as the shutter

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has passed the field of light, the strip containing the pictures stands still until the shutter again performs its eclipse; this picture is projected upon the screen as in a stereopticon or magic lantern.

It may be readily understood what a great precision was necessary in the construction of this apparatus, so that, in all these movements, the film, however so frail, may be preserved from serious injury in order to be used a great many times.

Thanks to the *reciprocating motion* given to the hook frame under the impulse of a *triangular eccentric*, we have attained this result (*the fundamental principle of our Patent*), and by these means the rapidly starting and stopping of the hooks can be regulated to a nicety and the driving motion begins only after the film has *absolutely stopped* so as not to spoil the holes. Moreover, the lateral openings of the film give a guide-marking so much the more perfect, as the former is executed by the means of hooks, which rigorously take back again the same positions at the two ends of their course. In sort, the mechanism is arranged in such a way that the film strip remains motionless during $\frac{2}{3}$ of the time while the other third is occupied in the substitution of the pictures. These advantages permit our "Cinematographe" to produce results which other similar instruments cannot compete with, owing to the fact that in such other instruments heavy sprocket wheels are stopped and started producing great vibration and noise and rendering the photographic strip liable to serious damage, besides giving an exhibition which, owing to these defects, is very trying to the eyesight of the spectator.

Description of apparatus.

The "Cinematographe" properly speaking (fig. 1, 2, 3), is composed of two essential parts. First the *eccentric axle*, second the *hook bearing frame*.

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(1) *The eccentric axle.* — This axle contains a number of

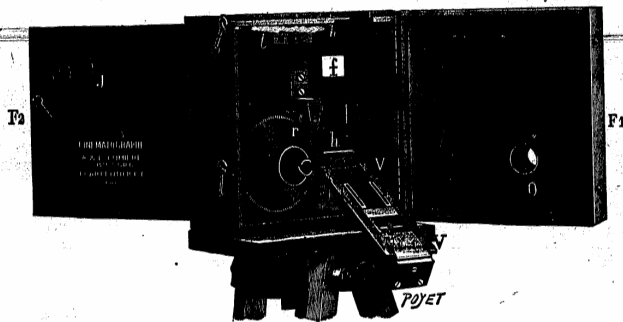


Fig. 1.

pieces which are as follows. At one of the extremities is fixed a pinion which catches into a toothed wheel R. (fig. 1) so that when the wheel makes one revolution the pinion makes eight. The toothed wheel is worked by the hand by means of a handle, which the operator should turn very regularly at the rate of about two revolutions in a second. Consequently the eccentric axle will give a speed of 16 revolutions in a second. Directly in front of the pinion is placed a friction roller (r) fixed on the shaft. This roller is bound with leather on its circumference. We shall see its use when dealing with the production of negatives.

Behind the pinion is fixed a triangular eccentric intended to transform the sustained circular motion of the axle into an

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alternative motion of the hook-frame. On the surface of the eccentric opposite to the pinion is screwed a thick circular disc concentric with the axle, carrying projected on its cylindrical

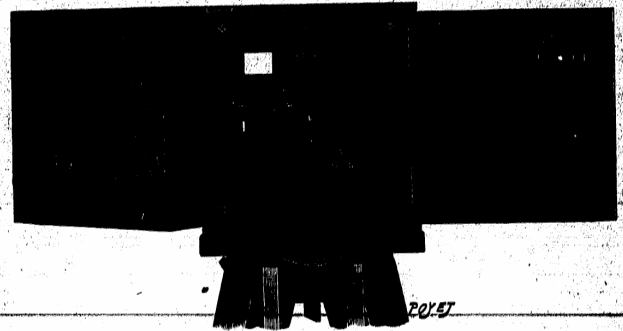


Fig. 2.

surface two parallel blades of steel. These blades, during a part of their journey are slightly deformed so that they present two internal projections, one destined for the catching and the other for the retreat of the impulse hooks. Finally, the second extremity of the axle is terminated by a tray on which is fixed the disc shutter by means of a nut (fig. 3). This is generally composed of two light metallic sectors which can be covered more or less so that the covering may have a fixed duration. The plate carries in front a peg which fits into the openings in the discs allowing their positions to be easily marked and to

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prevent their displacement during the working of the apparatus.

It may be observed that the nut which fixes the shutter is

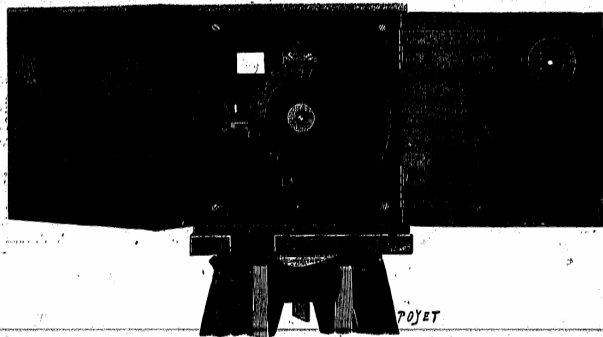


Fig. 3.

screwed left hand instead of right hand as is usual; to screw it, therefore, it is to be turned contrary to the hands of a watch.

The shaft is supported on two bridges at the two sides of a large plate of copper, called *platine*. The bridge on the pinion belongs to one arm; the other which holds the shaft between the eccentric and the shutter is double and arranged vertically.

(1.) *Claw frame.* — The claw frame is formed of a light blade of steel, with a rectangular window in it, in which the triangular eccentric works; it carries at its upper and lower extre-

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mities two straight guides which can slide freely, but without play, in the two slides which are made under the feet of the double bridge. In this way the frame, worked by the eccentric, receives a vertical alternating motion. On the side, and horizontally it is fitted with a prolongation supporting the carrying claws. Those, which are firmly fixed into one another, are perfectly guided in their movement, which is perpendicular to the plan of the frame. The piece that makes up their whole is provided laterally with a tenon on which the projections, mentioned above, work.

Working. — It is now possible to examine the working of the apparatus. Suppose the shutter removed and turn the shaft by hand, until the frame takes its upper limit of position and one of the projections of the disc produces the catching of the claws. From this moment, if we continue to turn, the frame descends by the action of the eccentric; after half a turn of the shaft, it takes its lower position, while the second projection comes forward to cause the claws to withdraw; then the frame rises again to its first position, the following projection causes the claws to take hold and so on. It is important to observe that the withdrawal or the grip of the claws takes place at each $1/6$ of a revolution of the shaft and that the ascent or descent of the frame takes place during a third of a revolution.

Accessories. — Towards the right of the apparatus is seen a shutter perforated with openings VVVV (fig. 1) which can be laid back and which is kept in a vertical position during work. Towards the upper part it has a glass with parallel faces *g*, supported by two springs, and intended to press lightly on the film; a little lower down are fixed two flexible springs *hh*, called "counter claw springs", in front of which the carrying claws are displaced. These springs prevent the tearing of the film, should an unforeseen accident occur during the unrolling. In the platine, facing the shutter, a shallow depression *AA* is formed lined with velvet, in which the film slides, kept in front by the shutter when the latter is raised.

At the upper part of this depression, facing the pressure

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glass, a rectangular window f , is formed whose size corresponds with that of the film picture.

All the apparatus is mounted in a walnut box, whose two moveable bottoms form two doors firmly held in place by hooks; one of these doors F , which faces the operator, possesses a circular opening O , by which the operating handle is introduced for working the apparatus. The other door is provided near the top in front of the above named rectangular window with a metallic annular disc J , on which the negative objective or the projection objective may be arranged.

To obtain Negatives.

To take negatives the following accessories are used :

- 1st A tripod to hold the apparatus.
- 2nd A frame-box.
- 3rd A receptacle box.
- 4th A Reel.

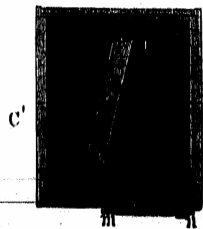


Fig. 4.

The frame box is a walnut box CC' (fig. 4), closed on one side by a sliding shutter. On the back, opposite the shutter, is fixed a rod O which supports the film; on this rod is pl-

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votted a plate ab pressed by a round spring r . In the lower angle a narrow slit is made lined with velvet.

This box is placed on the Cinematographe by means of the groove mn which works on a slide arranged with reference to the pressure shutter.

The frame box is intended to hold the film before it is being used, during carriage of the apparatus.

The receptacle box $AB, A'B'$ (fig. 5), which is entirely of metal, is intended to receive the sensitized film according as it is unrolled before the objective. It opens in two moveable parts around a hinge; towards the lower part AB' of the plan, opposite the lid, is a wide semi-cylindrical cavity which continues internally in the form of a sheath, which opens at the upper part of the box inside. The box is crossed from one part to the other by an axis of steel b , somewhat cone-shaped,

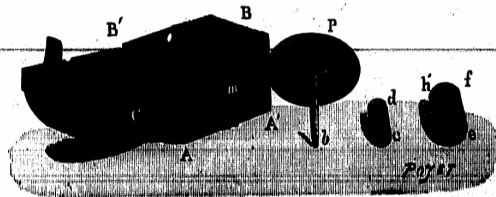


Fig. 5.

terminating on the left by a large circular disc P , which is pressed by the spring m against the friction roller of the shaft of the Cinematographe, when the box is in position. On this shaft and inside the box is arranged, to rub firmly, a brass cylinder

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cd, covered outside with india-rubber. A cylinder *ef*, of much greater diameter can revolve freely round this cylinder. It is provided at both ends with a generator of two hooks *hh*, in brass, for fixing the film. This particular arrangement has for its object to cause a kind of trembling between the two cylinders caused by the adhesion of the India rubber, so that the outer cylinder rolls up only the part of the film given up progressively by the carrying claws of the Cinematographe.

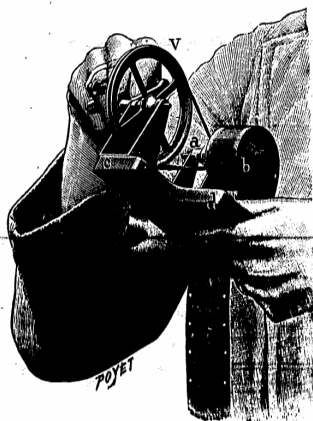


Fig. 6.

When the film is completely rolled up, it forms a compact roll filling up the interior of the box.

The receptacle box adapts itself to the shutter of the Cinematographe directly under the pressure glass.

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This adaptation is made by two tenons screwed on the shutter and which clasp a small tongue placed towards the top of the receptacle box. Two shoulders of the shutter support the box by the bottom.

Reel (fig. 6). This accessory serves to roll up the film. It is composed of a wheel *V* worked by a handle; this wheel, by means of a leather cord commands a kind of winch *ab* terminating on one side in a hollow cylinder split in all its length in form of a generating line. A shelf of walnut *cd*, held in the left hand, carries all; near the hollow cylinder, this shelf is provided with an opening lined with velvet. The end of the film, at first passed into this opening, passes further into the slit in the winch. The wheel is then turned with the right hand uniformly, until the film is rolled up. During this operation, it is necessary to be careful to guide the film under the shelf, by the fore and second finger of the left hand, in order to avoid twisting which might produce incurable tears.

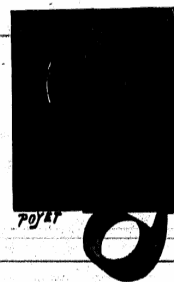


Fig. 7.

Manipulations. The manipulations necessary for obtaining negatives are :

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- A. *Introducing the sensitized film in the frame-box.*
 B. *Focussing.*
 C. *Putting the film in its place in the apparatus and working it.*

A. To introduce the sensitized film into the frame-box, it is necessary at first, by means of the reel, to unroll the ribbon that we send and roll on afresh, taking for the inside extremity the free end of the film, the *sensitized side being placed inwards.*

When this is done, place the roll of film in the central axis of the box, so that the unrolling movement shall be as the hands of a watch (fig. 7). The end of the band is to be folded towards the left, so as to surround the elbow lever, then it is led to the right passing it into the slit lined with velvet. Take care to let the end pass some centimeters beyond. Close the frame-box by means of the folding shutter and secure it with the button on the upper face. *Properly, this should be done in the dark room.*

B. *Focussing.* — The focussing is a most delicate operation, requiring all the care of the operator. It is evident in fact that the negative proofs should be as clear as possible, for as the positive, obtained by contact, must be considerably magnified in projection the smallest faults in distinctness would be exaggerated proportionally.

This focussing should be done generally on objects placed at a distance of 8 meters from the apparatus.

The ordinary objective for negatives is accompanied with diaphragms for moderating the quantity of light which falls on the sensitized film and to moderate, in a certain measure, the length of time for posing which should not be done with the shutter. A complete set of diaphragms consists of 3 parts, one large, one medium and one small. In choosing these diaphragms it must not be forgotten that the smaller their opening is, the smaller is the quantity of light that they allow to pass through and consequently the small diaphragms should not be employed to reproduce views badly lighted. On the other hand the smallness of the diaphragm increases the general clearness of the picture. It is therefore an advantage to work under conditions in which a sufficient lighting power is joined to the greatest clearness.

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The Zeiss objectif which can be adapted to our Cinematographe is provided with an iris diaphragm the manipulation of which is very convenient.

To find the focus, fix the Cinematographe with its objective on the tripod. Open the back door of the apparatus and place between the pressure glass and the corresponding window, a piece of film from which the coating of gelatine has been removed (the unpolished side towards the objective) and which makes a screen of very fine texture. Place in the objective the suitable diaphragm, then with a lens examine through the pressure glass the picture thrown on the piece of film, then slide the objective in the tube, which contains it, until the greatest clearness is attained.

It is possible that, time being short, the operator may have to act quickly to put the apparatus in its place and to be ready to work. For this purpose we have engraved a mark

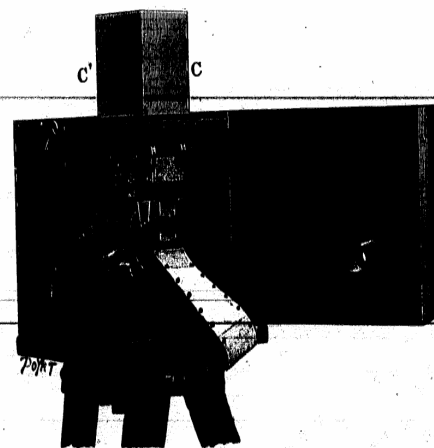


Fig. 8.

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on the polished part of the objective tube which, when it reaches the edge of the sheath, in which the latter slides, gives an automatic focus for objects more than 6 meters from the objective. We are convinced that this arrangement will render real services to our clients, by facilitating a delicate task, on which, we cannot too often repeat it, depends all the success in getting the negative.

Finally, it is necessary to watch very attentively to see that, once the focus is obtained, no displacement should take place at the tripod of the apparatus.

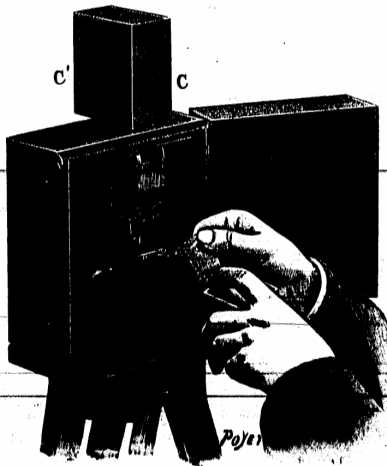


Fig. 9.

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Note. — It is important before fixing the focus to take note of the position of the shutter. We have already said that the latter consists of two superimposed discs. One of them, the lower, should never be disturbed from the position assigned to it by the mark-pin. As to the other, it is necessary, in order to obtain negatives, to decide its position so that with the first, it will form a complete semi-circle, which must be done by turning it as the hands of a watch but not the opposite way.

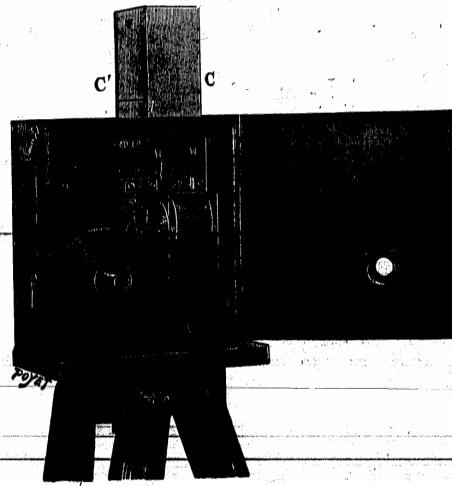


Fig. 10.

However when the light appears insufficient, and an insufficient pose is to be feared, it is not inconvenient to

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allow the two discs to remain superposed in the position indicated in fig. 8. The operation is then performed with a maximum of light.

It is important to be sure after this operation that the film slips freely in the sheath by turning the eccentric axle slowly between the fingers in opposite directions.

C. — *Placing the Film.* — Lower the pressure shutter by opening the bolt which keeps it vertical. Place the frame-box

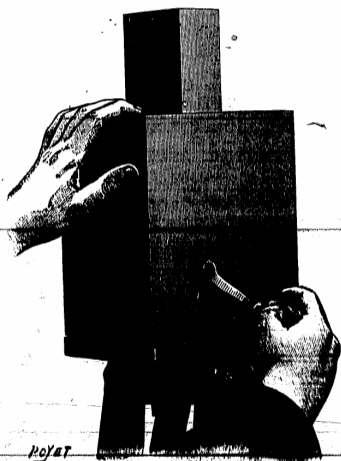


Fig. 11.

on the apparatus, fixing the under slide into the groove in the Cinematographe; the box being in place, the film which comes out of it should fill the velvet sheath. Pull the film just so far as to draw out about 25 centimetres. Introduce the claws

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(which have already been placed above) into the perforations; afterwards pass the end of the ribbon into the opening made in the shutter under the counter-claw springs and the shutter is to be raised and fixed with its bolt.

It is now necessary to arrange the film in the receptacle box. For this purpose take the closed box in the left hand, and with the right hand (fig. 9.) introduce the free end of the ribbon into the semi-cylindrical cavity of the box, guiding it with the left forefinger, push lightly on the film, until its end shows at the upper part of the interior of the box.

The box is then placed in the place made for it in the shutter, where it is held by the two upper tenons and the lower shoulder. In this position, the receiving box should completely cover the counter-claw springs; the circular disc at the end of the axle being placed on the left, make sure that it is properly held on the friction roller.

The box is afterwards opened by lowering the semi-cylindrical cover; draw towards you all the free part of the film, fix it in the two extreme openings in the clasps of the inside cylinder (fig. 10), roll on it all the free film, pressing firmly, and then shut the box.

The apparatus is ready for operation. Then close the back door of the Cinematographe, put the handle in the opening near the bottom at the left side, then at the proper moment turn the handle at the rate of two revolutions per second taking care to steady the apparatus with the left hand, pressing on the tripod to avoid shaking (fig. 11). At first most operators are apt to turn too slowly. Guard against this fault.

When the ribbon is completely unrolled (which is shown by the decreased resistance and the peculiar sound of the claws) withdraw the receiving box carefully; nothing now remains but to develop.

Precautions to be taken. — To avoid accidents during the process of obtaining negatives, it is indispensable to observe the following rules:

1° Be sure that the film slips freely, without shock, in its velvet sheath.

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2nd See that the window in front of the pressing glass is clean. Sometimes the velvet ravel, and the threads may cause marks on each of the negative pictures.

3rd Make sure that the pressing glass presses moderately on the film, regulate the pressure by the springs which hold it.

4th Carefully clean the velvet of the sheath with a badger brush to remove dust which would certainly spoil the film.

5th See that the sensitized side (dull side) of the film is turned towards the objective, and consequently the polished side towards the operator.

6th After obtaining each negative, remove with a wooden spatula the gelatinous grains which often stick to the semi-cylindrical cavity of the reception box.

7th Be sure that the friction roller adheres perfectly to the circular disc of the receptacle box. This adhesion can be increased, if required, by means of a light coat of wax spread on the friction roller.

8th Never stop in the middle of an operation for in recommencing there may be difficulties in reeling again.

Developing, Washing & Fixing.

The operations of developing, fixing and washing films may be conveniently performed by means of simple baths of 10 litres capacity.

The developer is prepared according to the following formula :

Water.....	10 litres.
Diamidophenol.....	50 grammes.
Anhydrous sulphite of soda....	250 grammes.

(The relative proportions of Diamidophenol or Sulphite may be modified).

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This quantity of liquid represents the contents of one bath. For developing 2 baths of the liquid are prepared.

The film, rolled in the form of a bobbin, is supported above the first bath by a cylindrical rod which passes through the central orifice of the bobbin. This rod (a pencil for instance would do) is held in the hand of an assistant, or can be fixed, by a very simple means, to the wall of the dark room. The film is then *very rapidly* unrolled and is immersed in the developer as it unrolls. When the whole film is unrolled, pass it, still very rapidly, into the second bath, being careful to slide it between the two fingers in such a way as to expose all of its surface to the developing liquid and to avoid bubbles or gaps in development which might otherwise occur.

It is necessary that the immersion in the first bath and the transit from the first to the second bath *take place as rapidly as possible*.

The film is afterwards passed from one bath to the other continuously until the development is deemed sufficient. When this result is obtained the film is immersed in a bath filled with water where it is washed; the water bath being arranged in such a way that the film leaves the second bath of the developer and enters the water with the same end foremost which was first dipped in to the developing liquid at the beginning of the operation. In this way the development will be uniform throughout the entire length of the film.

The washed film is passed into a first and thence into a second fixing bath of Hyposulphite of Soda at 25 %. When fixed, it is placed in a washing bath, where clear water is constantly renewed, and where it remains several hours.

If the film is dried immediately on leaving the water, it curls up and may suffer some contraction.

To avoid this it must be glycerined.

The formula for the bath to be used is as follows :

Water.....	7 Litres 500 cent. cub.
Alcohol (A 95 %)...	2 " 500 " "
Glycerine.....	250 " "

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Two baths are to be filled with the liquid for glycerining, and the film should be dipped successfully into each.

This operation should take *5 minutes altogether*.

The glycerined film is dried by suspending it on a wooden rod in a dry place, and at a temperature of 20° to 22° centigrade.

When it is dry it is rolled up by means of a reel and is then ready for introduction into the Cinematographie.

Great precautions must be taken in passing the film from one bath to another during the various operations of developing, fixing, washing, and glycerining, in order to avoid peeling of the coating, which very easily occurs, especially if the film be creased or folded.

The advice given above should be observed with reference to development, namely, to be careful to slide the film between the fingers so as to smooth out creases.

Care must always be taken to place the sensitized side uppermost in order to avoid rubbing it against the edges of the baths.

It is difficult to obtain by development in baths very regular and uniform pictures along the full length of the film. We have at our works a special apparatus for the development of films by which we can obtain with certainty perfectly regular pictures, and we offer to develop for our clients, at a very moderate price, the views they have taken.

To obtain the Positive.

To obtain a positive from any negative a frame-box is used with two spindles P' (fig. 12).

The negative N is rolled around the lower spindle with the coating of *gelatine outside*, and the sensitized film P is rolled round the upper roller with the *gelatine inside*. The two free ends pass through the lower slit in the box. — This is done in the dark room.

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Treat the two strips afterwards as if for obtaining negatives, with this difference that the positive film only is introduced into the receiving box, while the negative passes out through the slit in the bottom of the apparatus into a basket or other receptacle placed under the apparatus. The two discs of the shutter are so placed that they form a complete semi-circle, as explained on page 17, viz., by turning the upper disc to the right.

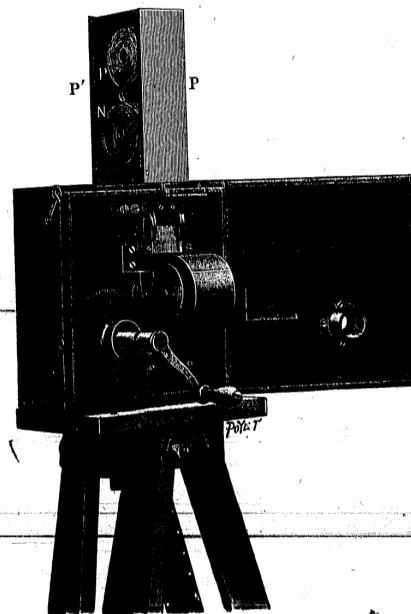


Fig. 12.

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To Operate.

Close the apparatus, unscrew the objective and place in front of the opening at a suitable distance a light such as a gas jet, petroleum lamp etc.

The distance at which this light must be placed depends on its nature, on its intensity, and on the strength and transparency of the negative. It is therefore impossible to give any exact rule on this subject; preliminary and methodical trials are the only means of informing the operator.

The light being properly placed put the apparatus in motion. The negative strip will be gathered in the receptacle under the apparatus, while the positive stows itself in the receiving box.

Projections

The apparatus for projecting is composed (besides the Cinematographe with its projection objective), of an electric lamp with hand adjustment, a rheostat, a stand and a screen. These various parts are arranged as in fig. 14. We give the following as a brief description of the several accessories:

(1) The Lantern.

The Lantern is a metal box or house containing the electric lamp and is fitted in front with a spherical condenser, which concentrates the electric light rays on the pressure glass of the Cinematographic. A side door in the lantern, which has a circular opening, furnished with a dark colored glass, allows the operator to examine the carbons of the lamp.

The spherical glass condenser (fig. 13), is a simple sphere B filled with water (preferably distilled or with some drops of acetic acid added), which is encased in a metal cylinder E,

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fixed to the front of the lantern A by four rods each terminating in a screw V.

This cylinder is prolonged in form of a tube F, the end of which has a hinged shutter furnished with a ground glass H. This shutter is open the instance the film is set in motion. This sphere is used just like an ordinary condenser. It is necessary in regulating the light to turn the sphere on its axis in order to give it the position in which the luminous spot is most regular.

This spherical condenser is a very great improvement over the ordinary lense, the latter having the effect of concentrating the heat on the film which might take fire if an unpracticed

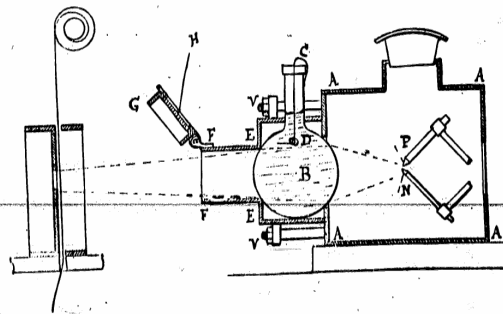


Fig. 13.

operator left it in a state of repose, too long exposed to the concentrated ray. With our globe (in place of the lense), the luminous rays are concentrated without loss of illuminating power; the light is even whiter, the effect of the green color of the lense being eliminated and the heat rays are almost entirely absorbed by the water. After 30 or 40 minutes use the water in

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the sphere commences to boil; this however, causes no inconvenience. To prevent the water spurting out during boiling, put in a small piece of coke D, suspended by a wire C; the boiling then goes on with the greatest evenness.

If the globe must be taken out for any cause during operation (if it breaks, if the water leaks or evaporates) the condensation of the light rays ceases and there is no further fear of heating.

Thanks to this device it is impossible to commit dangerous error, the concentration of the rays being produced by neutral bodies which absorb the heat.

Arc Adjustment.

The arc-adjustment is essentially composed of 2 metallic rods holding the carbons through which the electric current passes. These rods by means of polished buttons, worked by hand, can be changed in position every way, so that the arc may be always in line with the condenser and the press glass, and the entire lamp may be moved more or less near to the condenser or swung from side to side.

The electric current is conducted to the apparatus by two wires corresponding respectively with the upper and lower carbon. Where direct current is used the positive pole of the line wire should be connected to the upper carbon. To light the arc touch the carbons together and then separate them quickly. The arc forms immediately and a good light is obtained by keeping the carbons $1/3$ to $1/4$ inch apart for a current of 15 amperes.

(2) The Rheostat.

The rheostat regulates the discharge of the current by introducing a resistance variable at the will of the operator.

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It should be near at hand in order to regulate it without leaving the apparatus.

Projection Objective.

The objective or projecting lense is for giving a clear and magnified picture of the film photograph on the screen. It is out in the same place as the negative objective but is furnished with a rack and pinion allowing elongation and contraction in the direction of its axis in order to obtain a focus on the screen.

(3) The Stand.

The stand on which the entire instrument is mounted (fig. 14), is a wooden support for the Cinematographe and its lantern. The Cinematographe is fastened in front by a screw, the lantern is placed at the back. In front and under the Cinematographe is a receptacle to hold the films after they pass through the mechanism.

The stand should be fixed on a solid foundation to avoid any vibration and should be sufficiently high so that all the rays issuing from the objective lense pass over the heads of the spectators. On each side of the stand an independent plank can be placed for the operators to stand upon.

(4) The Screen.

The screen should be made of white linen, without seam; its dimensions should be not less than 2 metres in width and 1.60 in height.

When projecting with the screen placed between the apparatus and the spectators, it is necessary in order to make the screen transparent to moisten it with water containing 10 % of glycerine.

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Projections formed by transparency show *reverse* scenes from those which are projected from the front of the screen. Should it be necessary to restore the action of the scenes, to show on the right that which was on the right in nature, turn the film around, by reeling it with the dull surface inside.

Electric Lighting.

The lighting of the room should be divided into two groups of lamps, one of which remains extinguished during the whole of the performance, the other only during the passage of each film and is relighted immediately after.

These lamps are controlled by switches usually furnished by the electrician in charge of the installation. It is well to employ a double switch for the group, which is to remain extinguished during the performance, so that in cutting off the current from the group you switch it on the projecting lamp.

Electric installations are always provided with safety fuse blocks which arrest the current in case (on account of some unforeseen cause) it becomes too intense. They should be placed near at hand so as to be easily replaced. It is better to use direct than alternating current as the former gives a more intense light.

Projections.

To use the arc light in projecting to the best advantage certain precautions are necessary. First, the segments of the shutter must be arranged so that they cover one another as indicated in figure 3; this arrangement allows the maximum amount of light to pass on the screen.

The lantern being in place and the Cinematographe removed, the light falls on the screen in the form of a circle, the centre of which should be in the middle of the screen. The lamp is moved forward or back until a clear and brilliant shadow of

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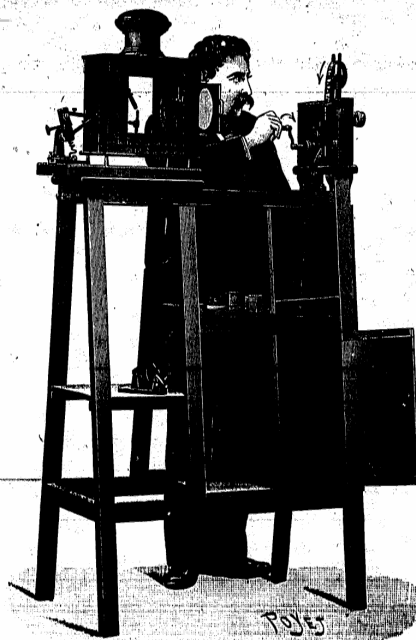


Fig. 14.

the two carbons is shown. The Cinematographe is then put in place and its objective lense is adjusted until the image of the window is shown in the centre of the screen, then get the focus.

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Management of the Apparatus.

To pass the film a film carrier is used which is better than a frame box (see fig' 14 et 15). This carrier is composed of two brass uprights AB and CD joined by a base-piece. The upright AB has two horizontal rods EF. The upright CD is hinged to the base so as to open out and allows the roll of film to be placed on the rod F. By means of the reel the film strip is rolled, *gelatine outwards*, commencing at the finish of the subject. The upright CD is opened out and a roll of film is inserted so that, in unrolling, the gelatine side is towards the operator. The free end of the Film is then passed over the upper rod and is inserted in the velvet slot, the work then proceeds as in taking negatives.

The arc light being adjusted the shutter of the condenser is opened, the light in the room is turned out, and you have only to turn the handle at the rate of two revolutions per second. When the film is entirely unrolled, the light in room is partially turned on and at the same time the shutter of the condensing apparatus should be closed. The next roll is placed on the carrier while the assistant is reeling up the film which has just passed.

Care of the Apparatus and Films.

The Apparatus should always be kept clean, and the revolving or sliding parts slightly lubricated with vaseline or with a mixture of petroleum and olive oil. If clogged the parts should be cleaned with a brush dipped in benzine. While cleaning, carefully avoid in producing anything between the eccentric and the hook bearer which might seriously derange the apparatus.

The press glass should be carefully cleaned after the pas-

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sage of each film to remove dust which would spoil the film by marking it with lines.

The objective lenses should be cleaned with a camel's hair brush or silk. Avoid rubbing as much as possible.

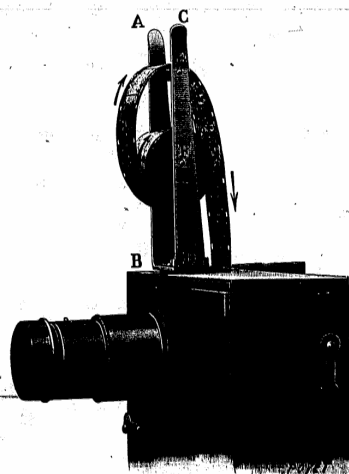


FIG. 15.

Films should be kept pliable, for which purpose use a zinc moistening box separated into two compartments by a netting of metal cord. In the lower compartment place a thick felt or piece of sponge saturated with water. In the upper compartment and on the wire netting place the films in their tin boxes, uncovered. During the performance the moistening box may

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remain uncovered. When the performances are all finished roll the films, dull side out, and leave them shut up in the moistening box until again required. New operators sometimes tear the film during projection. These tears are usually at the point of perforation; to avoid them make sure before each performance that the pressure glass does not squeeze the film too tightly, that the latter slides easily in the velvet slot, and that the carrier is properly in place. Tears should be repaired at once, otherwise they give rise to further tears. This is easily done by cementing with acetate d'amyle a small piece of celluloid to the back of the film (bright side); then make a new perforation of the desired size. A piece of an old film from which the emulsion has been removed by washing in warm water, will answer.

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LIST OF MATERIALS.

The materials required for the production of Animated Photographs by the Lumière « Cinématographe » are composed of:

- A. — A Cinématographe comprising the following accessories :
 - 1° A frame box with two axles for obtaining positives ;
 - 2° Two frame boxes with one axle for obtaining negatives ;
 - 3° Two receiving boxes ;
 - 4° An objective lens for negatives ;
 - 5° An objective lens for projection ;
 - 6° A handle ;
 - 7° A reel ;
 - 8° A film-carrier.
- B. — A projection lamp with spherical condenser ;
An electric arc lamp with hand adjustment.
- C. — A rheostat.
- D. — A stand for projection.
- E. — A tripod stand for taking negatives.
- F. — A moistening box.
- G. — Extra press glasses.
- H. — Springs for press glasses.
- I. — Springs for hooks.
- J. — Cleaning accessories, viz., brush, screw-driver, pincers, camels hair brush, paint brush, syringe, oil-can, chamois leather etc., etc.

K. — Six Films.

306.00

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Table giving dimensions of Pictures projected on the screen
by various

Objective Lenses for projection at specified distances.

(.374) SHORT FOCUS OBJECTIVE ($\frac{1}{3}$ -)

DISTANCE BETWEEN THE SCREEN & APPARATUS	DIMENSIONS OF PICTURES
5m 80.....	1m 50 X 1m 15
8m.....	2m X 1m 50
11m 50.....	3m X 2m 25
19m.....	5m X 3m 80
23m.....	6m X 4m 50

(.236) MEDIUM FOCUS OBJECTIVE ($\frac{1}{4}$ +)

DISTANCE BETWEEN THE SCREEN & APPARATUS	DIMENSIONS OF PICTURES
8m.....	1m 50 X 1m 15
10m 50.....	2m X 1m 50
16m.....	3m X 2m 25
25m.....	4m 70 X 3m 50

(.178) LONG FOCUS OBJECTIVE ($\frac{1}{5}$ -)

DISTANCE BETWEEN THE SCREEN & APPARATUS	DIMENSIONS OF PICTURES
10m 50.....	1m 50 X 1m 15
14m.....	2m X 1m 50
21m.....	3m X 2m 25